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***Energy Security: A Global Challenge***

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By  
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# The Emerging Petroleum and Natural Gas Economy

Ft. McNair, Washington, D.C.

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Sept 30, 2009

**Director & Senior Fellow**

CSIS

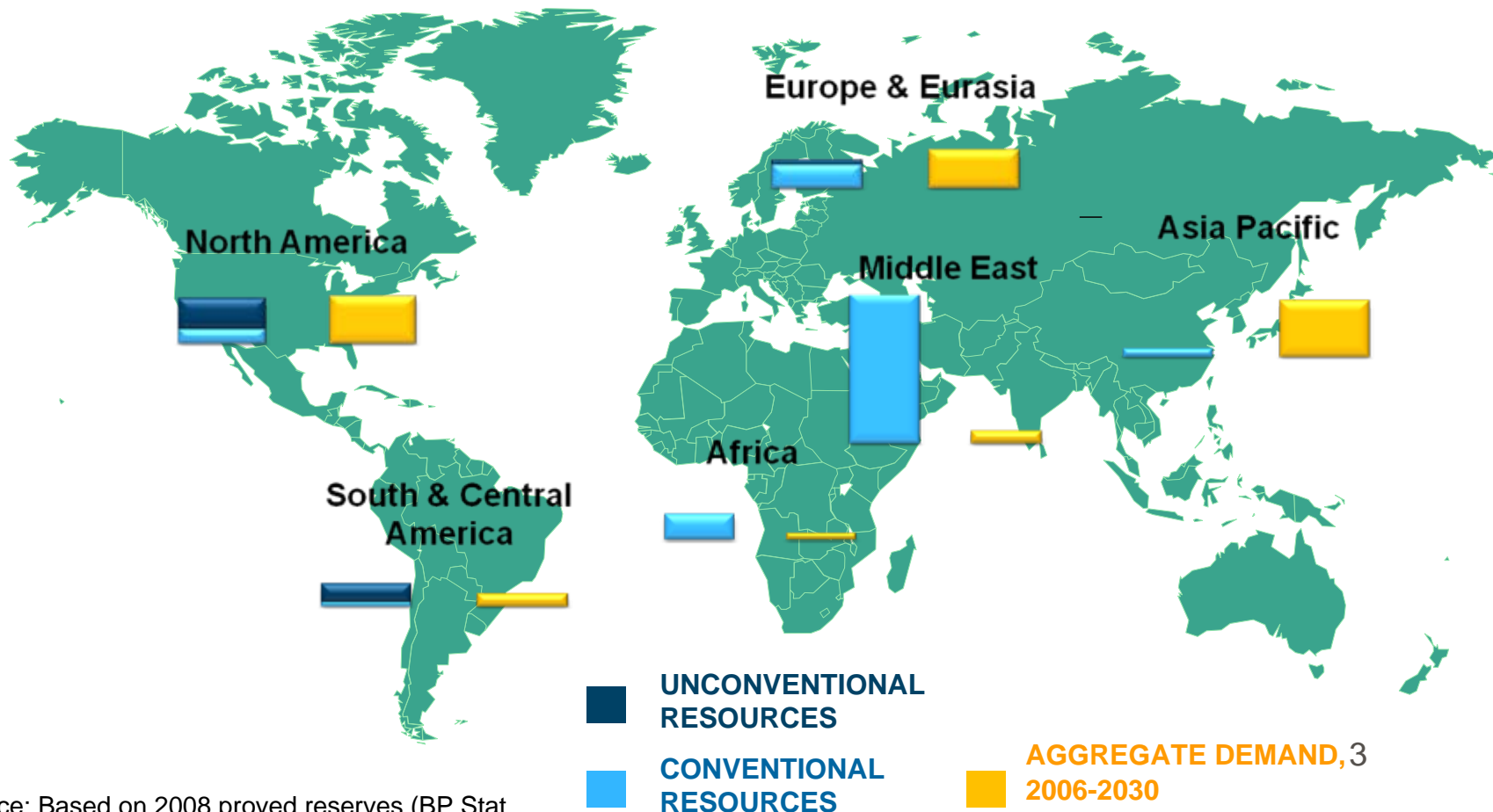
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## Topical Focus

- Peak Oil
- Technology Developments
- NOCs & IOCs
- Game Changers
  - **Climate**
  - **Natural Gas**

## Beyond Peak Oil: Global Resource Endowment is enormous, but conventional distribution is uneven and unconventional have environmental challenges

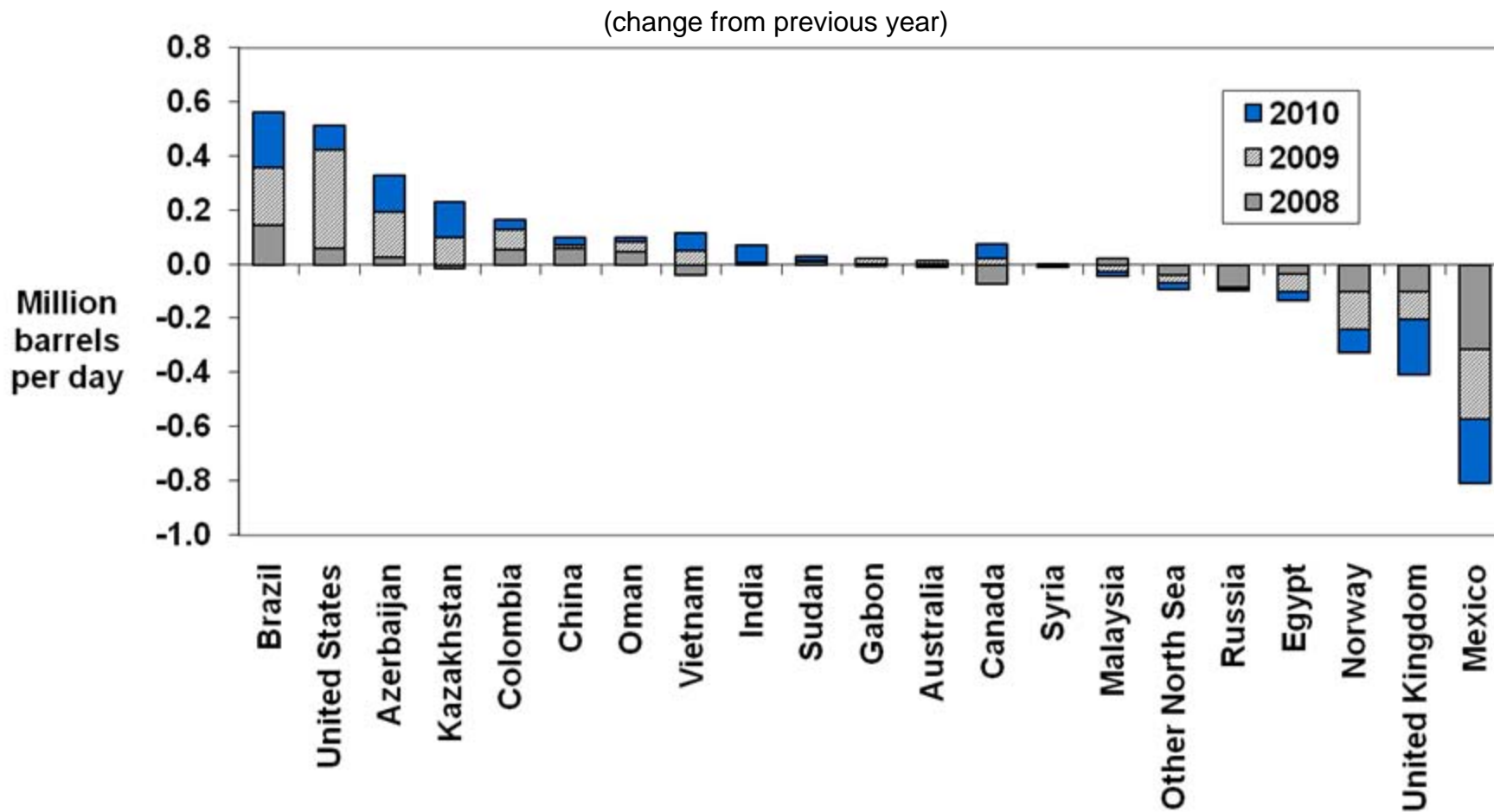


Source: Based on 2008 proved reserves (BP Stat Review) and 2006-2030 demand trends (EIA)

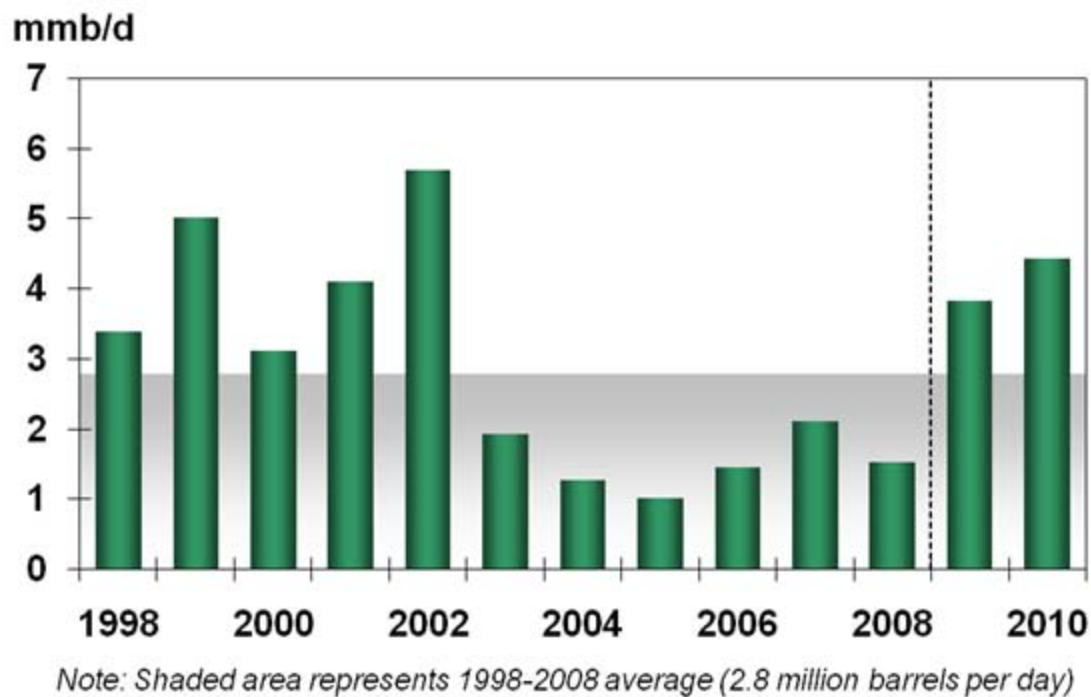
# Geopolitical & governance risks are accumulating



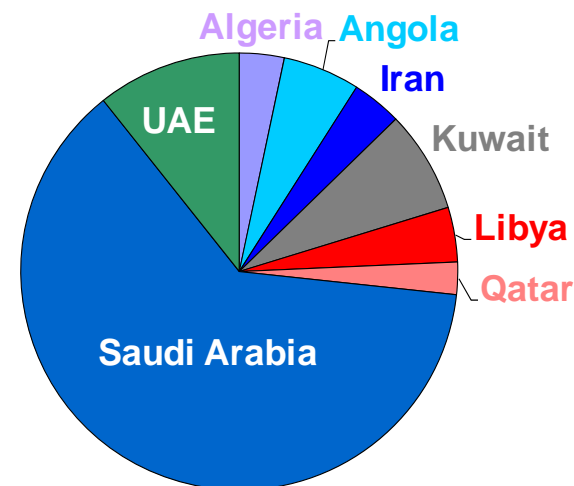
## Non-OPEC Oil Production Looks Flat



## OPEC Surplus Production Capacity

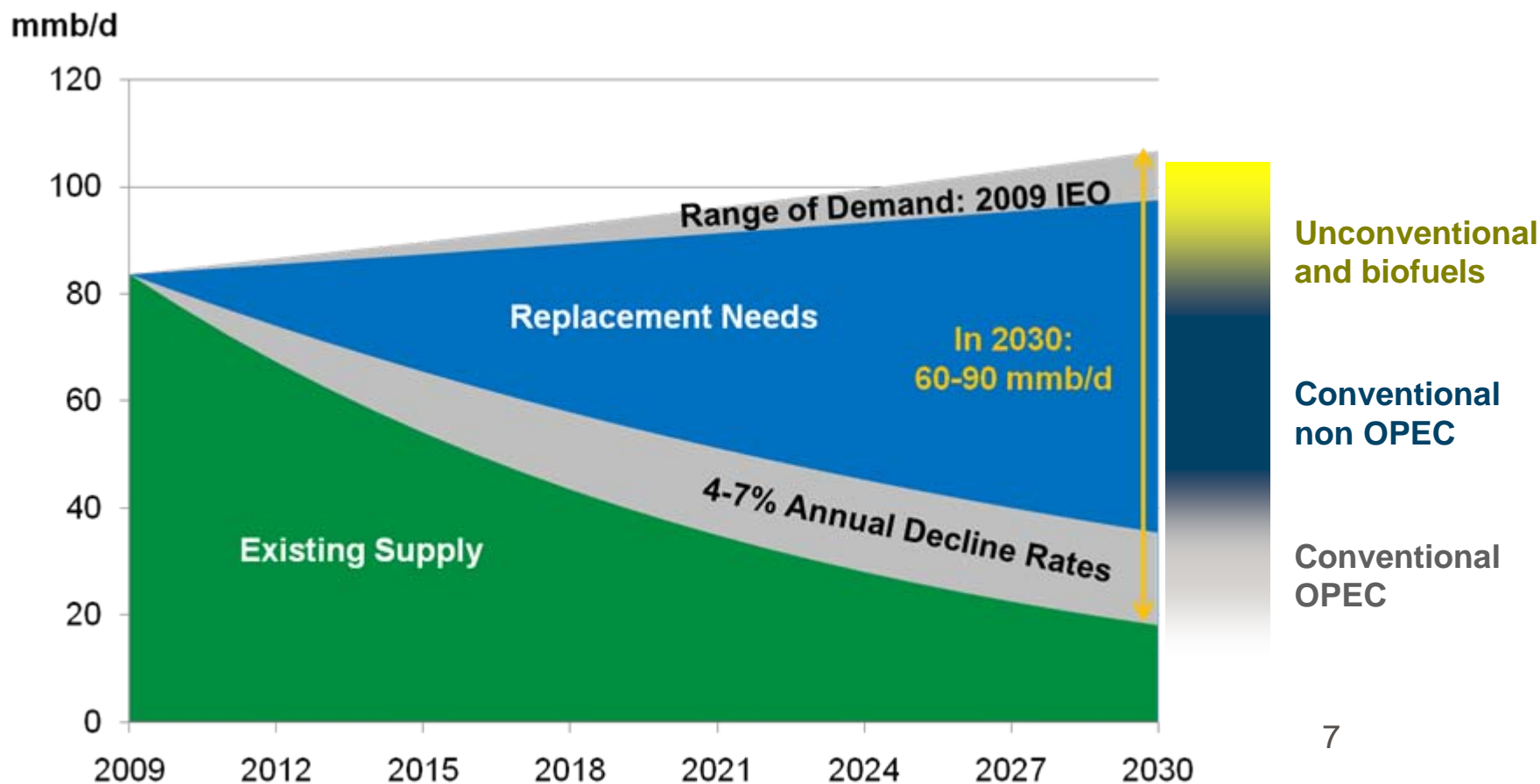


**Surplus Capacity, by Country**  
Total Current (est.): 5.5 mmb/d

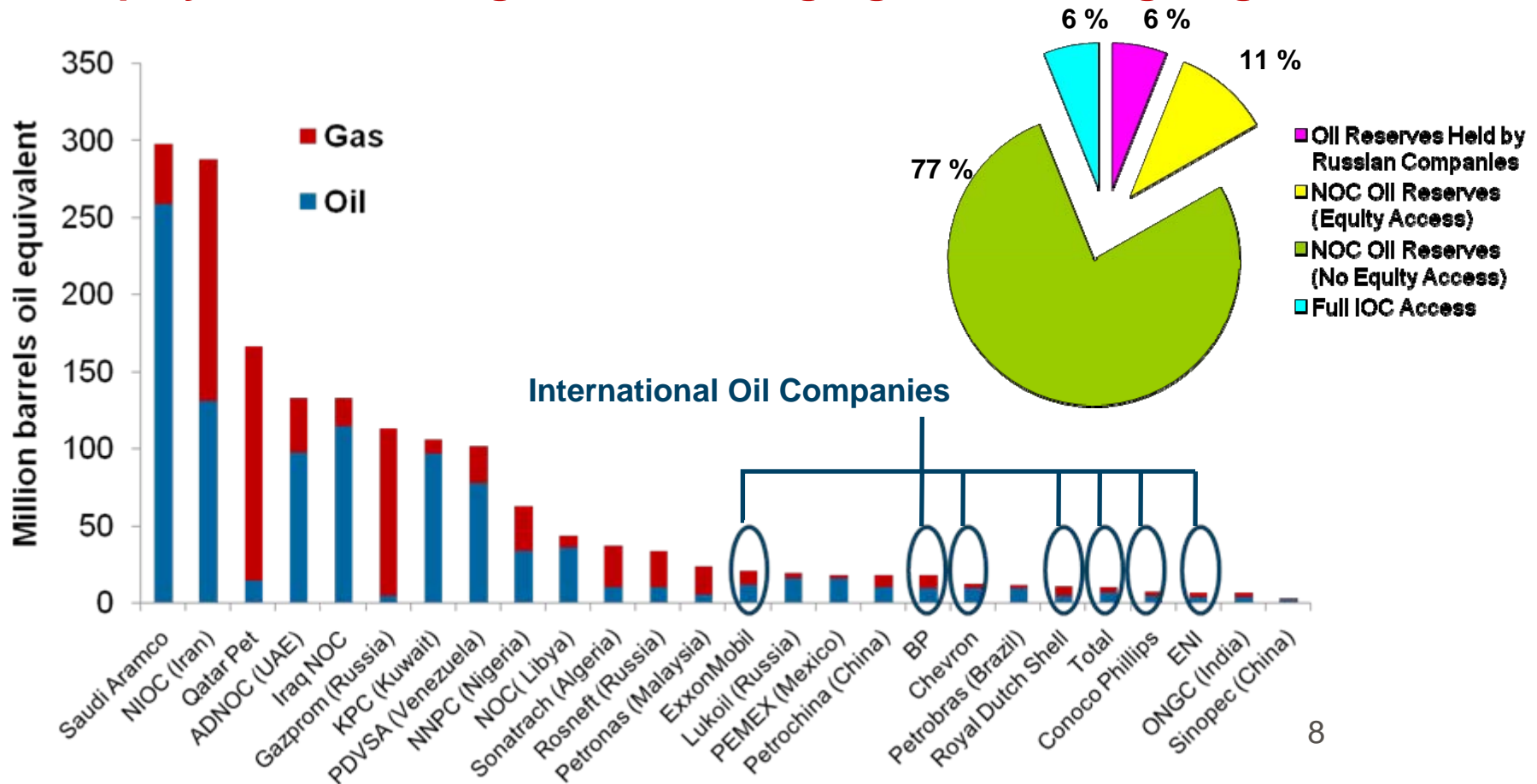




## Replacing Global Liquids Supply Will Be Challenging



**15 of the Top 20 Largest Oil Companies are NOCs;  
NOCs control 80-90% of conventional oil and gas reserves;  
Will play an increasing role in managing resources going forward**



## **All NOCs are NOT alike, but they share certain priorities and objectives:**

- Agents of host governments
- Protectors of the National Resource Patrimony
- Source of Revenues needed to fund other programs
- Responsible for Social development & infrastructure
- Role in International relations
- Stakeholders are Political
- Management practices, operating standards and agendas different from IOCs

## A Word on Technology Advancements

- Better diagnostics, intelligent wells
- GeoSteering
- Improved reservoir simulation
- Pre-salt experience
- Maximum Reservoir Contact Wells
- Sub-sea completions
- Rez “Bots”
- Horizontal drilling (shales)

**Bottom Line: Significant new discoveries (BB fields), improved accessibility & increased recovery rates**

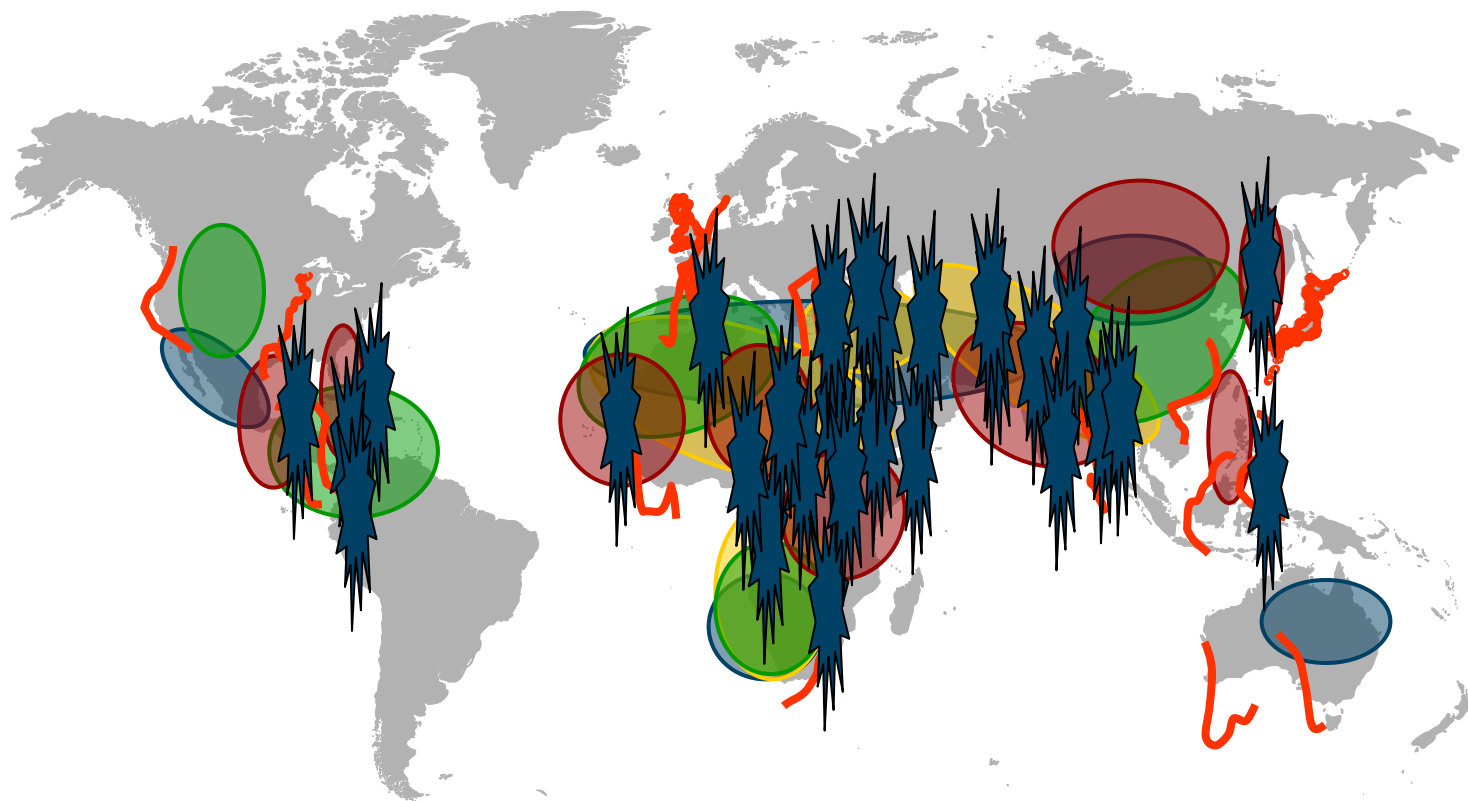
## Game Changers

- **Climate Change and Regulation of Carbon & GHG Emissions**
- **Exploitation of Unconventional Shale Gas Reserves**

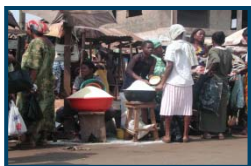
## Climate Change as a Game Changer

- Affects supply & demand
- Alters fuels choices, increases prices
- In the extreme, raises security concerns
- New investment & technologies applied on a global scale
- Implications of a fractured vs. unified response
- Concept of “Sustainable Development” challenges traditional view of economic prosperity
- Requires long-term global policy solutions and trade-off balances

## Climate Change as a Threat Multiplier



**Water Scarcity**



**Demography**



**Crop Decline**



**Hunger**



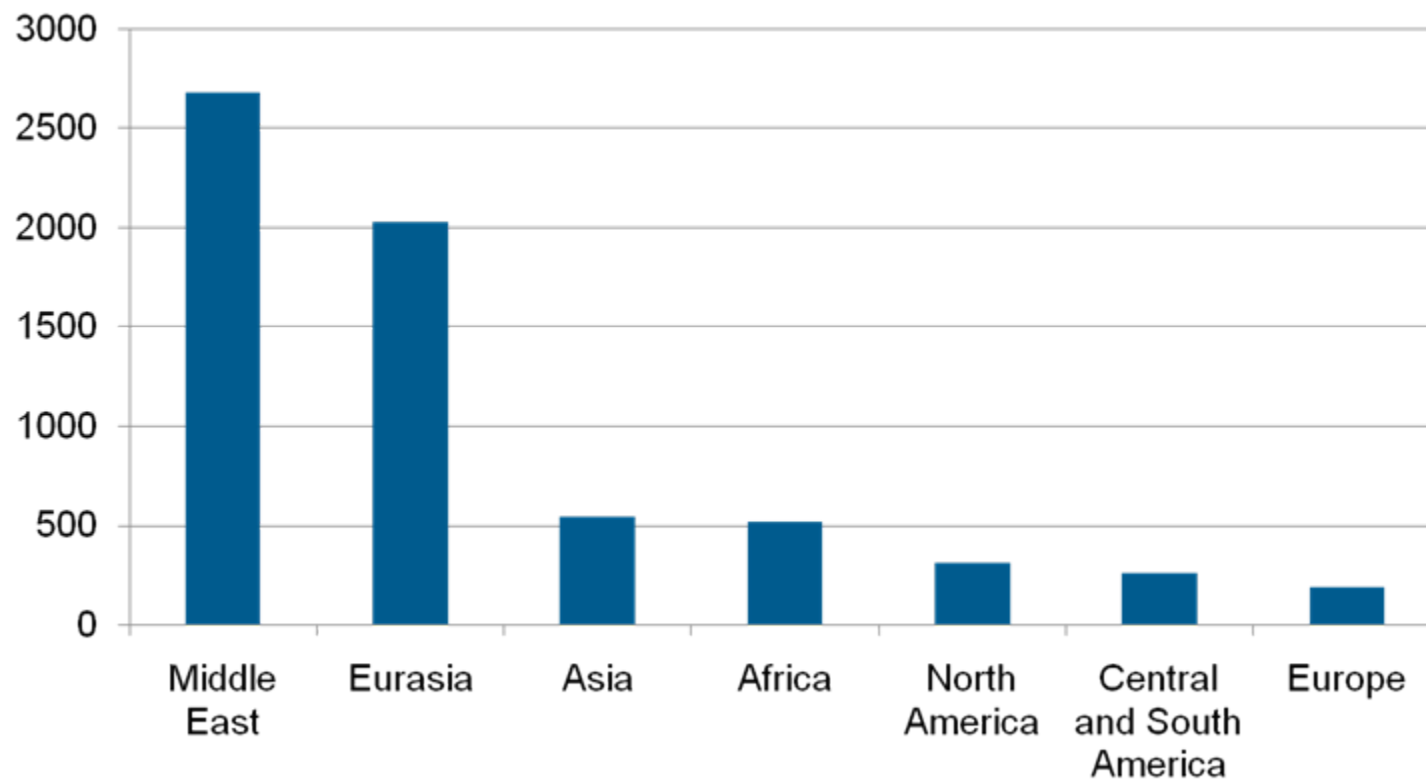
**Coastal Risks**



**Recent Conflicts**

## Conventional Global Natural Gas Reserves

trillion cubic feet



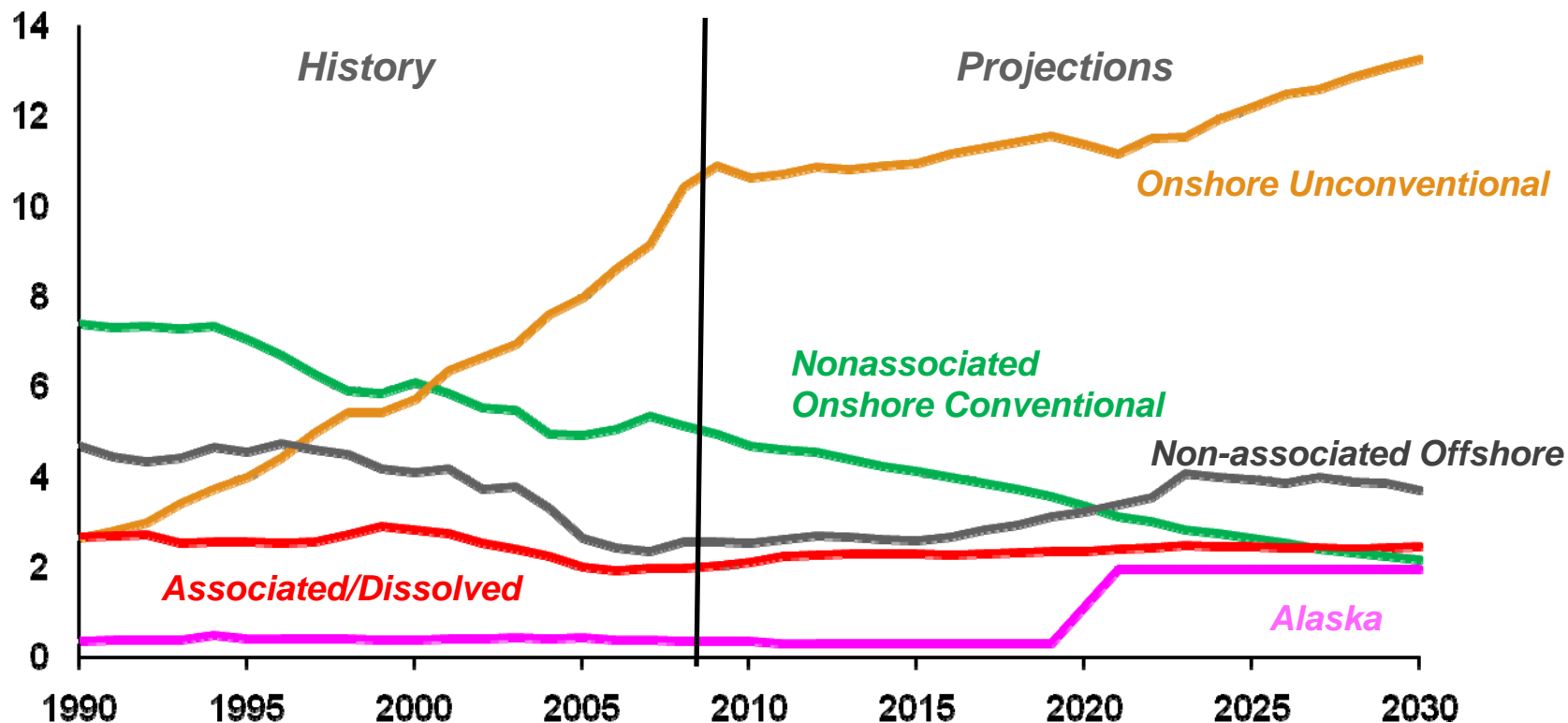


## Global Gas Supply Dilemma

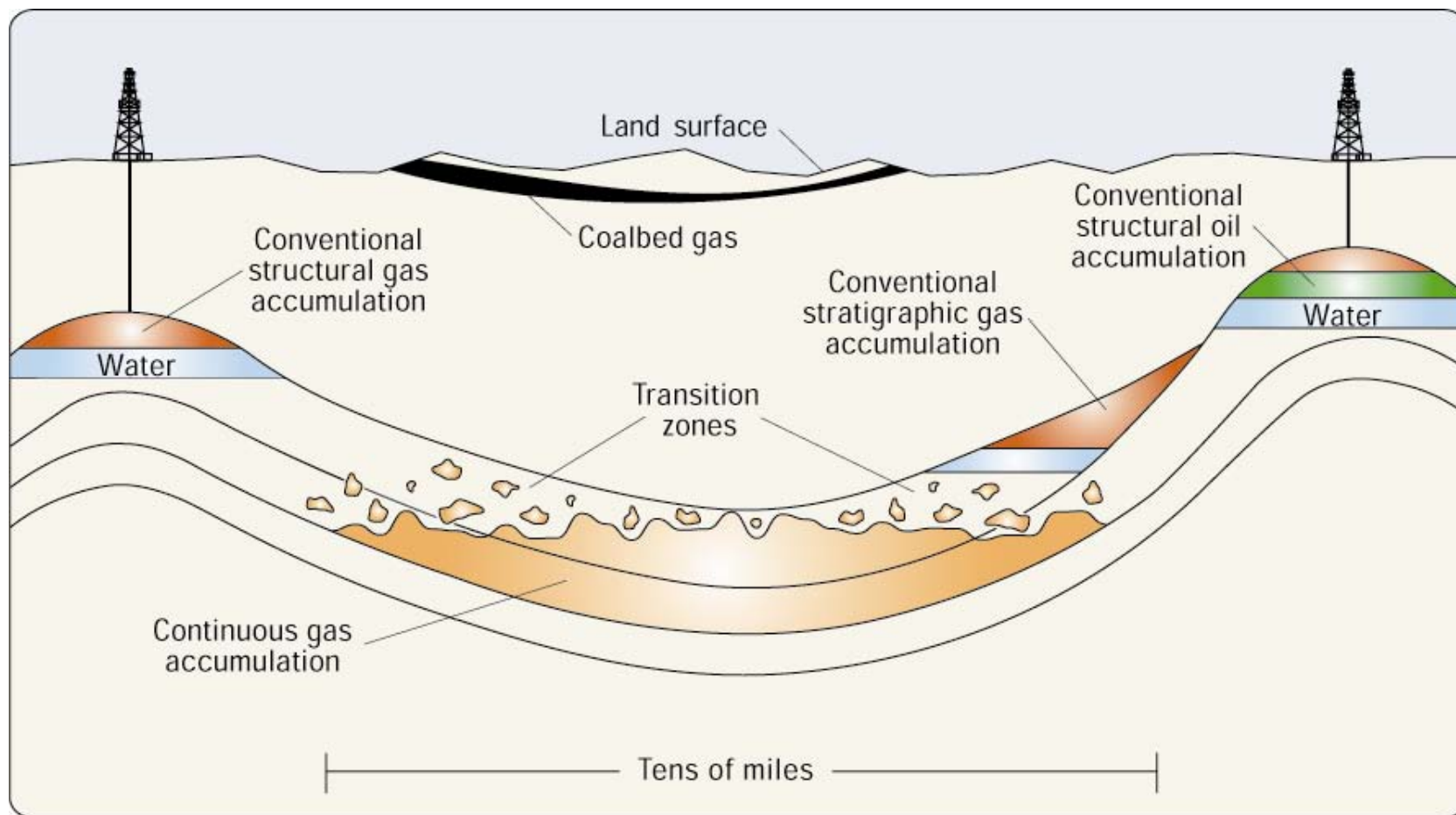
- Global gas demand to grow, especially in a carbon constrained world
- Conventional supply sources become more concentrated geographically
- Concentration can affect leverage, supply and prices, geopolitics, etc.
- Delivery system under greater stress
- Price rise + increased import dependence recreates balance of payments concerns

## What's New?: Substantial growth in U.S. natural gas production through 2030 led by unconventional...

trillion cubic feet



## Conventional vs. Continuous Resources



## Game-Changing Potential: Estimates of US Shale Gas Resources

EIA Annual Energy Outlook 2009: **267 tcf** undiscovered technically recoverable shale gas resources (mean)

- Based on 2007 U.S. Geological Survey assessment and 2006 Mineral Management Service data

Navigant Consulting Inc. 2008: **274 tcf** undiscovered technically recoverable shale gas resources (mean)

- Based on aggregated data from numerous studies

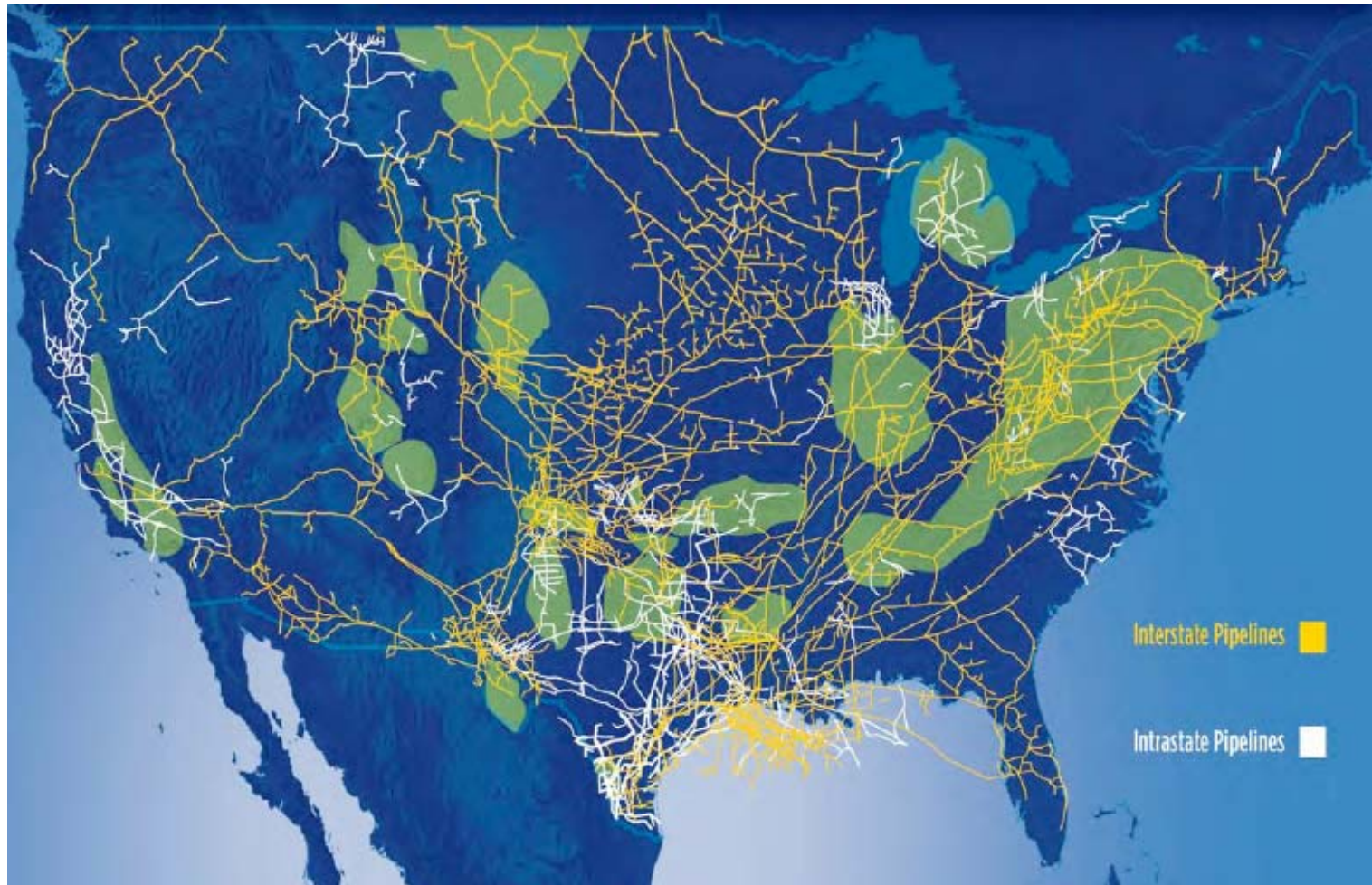
Navigant Producer Reports 2008: **up to 842 tcf** undiscovered technically recoverable shale gas resources (max reported)

- Ascertained by Navigant in 2008 study (accounts for Marcellus and Haynesville)

Potential Gas Committee 2009: **616 tcf** undiscovered technically recoverable shale gas resources (mean)

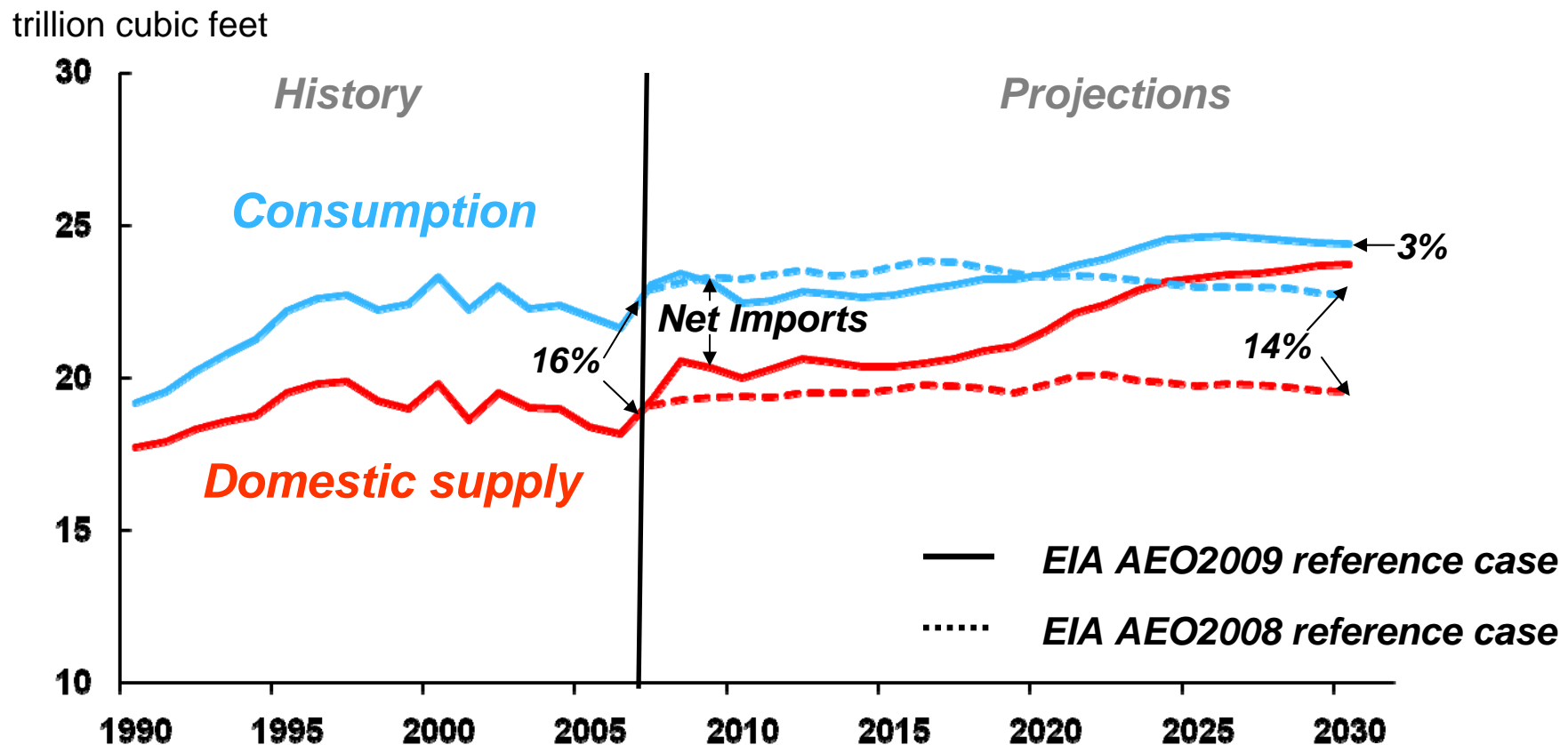
- **Estimated total U.S. gas resources of 2,074 tcf** (mean undiscovered tech recoverable + reserves)

## Shale Resources and Natural Gas Pipeline Network





## New US Domestic resources mean less imports (pipeline gas and LNG) and more supply choices for the world!



## Implications of Global Shale Gas Exploitation

- Development of US shale formations would free up LNG for use elsewhere
- Significant shale prospects likely in China, Turkey, Australia and Europe
- Development of indigenous gas sources, coupled with LNG, efficiency, renewables and interconnects could reduce EU reliance on Russian gas
- Global gas surplus could revamp price/contract structures





**BUT ...realizing the full promise of shale resources is not a certainty and US domestic policy is important!**

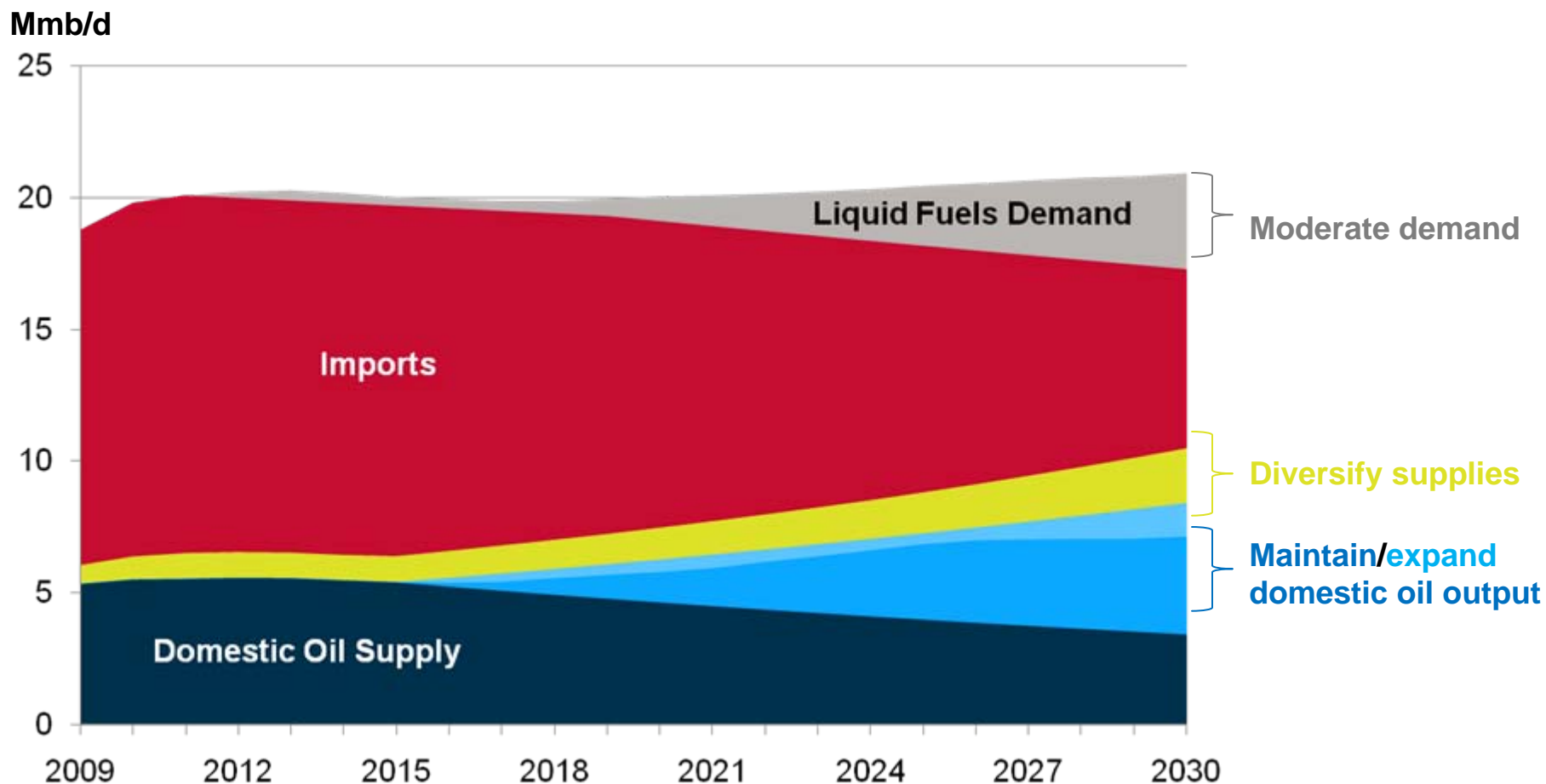
## **Technical/Economic Challenges**

- All shales are not alike; application of drilling/reservoir fracturing technology & operational experience matters
- Steep decline rates require ongoing investment and drilling; and repeated fracturing
- Up front investment (lease acreage and pilot wells) not insignificant vs. cost basis relative to commodity price/value

## **Environmental/Regulatory/Societal Challenges**

- Uncertain regulation (hydraulic fracturing, water, land use, permits), “industrialization” of areas unfamiliar with development plans and associated impacts
- Location, location, location – shale resources are, at times, proximate to and distant from delivery infrastructure and demand centers – both present problems

## Strategies to Enhance Oil U.S. Security Count



## Policy Model

